Northwest
Micro Mineral
Study Group

# MICRO PROBE

**SPRING, 1996** **VOLUME VIII, Number 3**

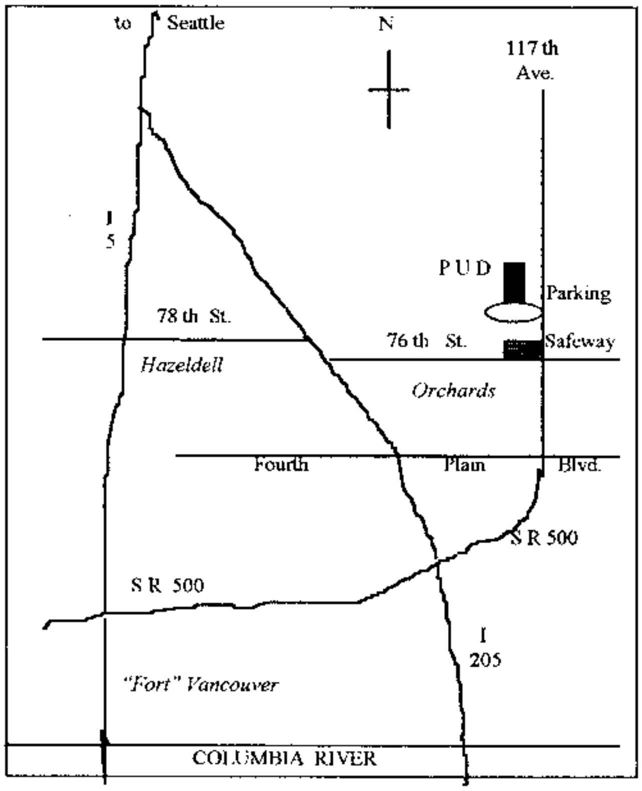
## SPRING MEETING . . . . . . . . . . . .VANCOUVER, WASHINGTON

**May 4, 1996 9:30 am to 6:30 pm**

**Clark County P. U. D. Building**
**Orchards Office**
**117 th Avenue just north of 76 th Street**

*Notice the change in the meeting site!!!*

Due to remodeling at our usual meeting site on Ft. Vancouver Way, we will be meeting at the other PUD building in Orchards. It is easily reached from I205. State road 500 goes right past the front door. Park on the south end of the building, and enter using the south door.




There will be a short business meeting at 1:30 with a chance for everyone to share information about collecting. We are hoping to have pictures of Antarctica from Mike Davis. If you have slides of minerals or collecting sites to show please bring them.

We will have the usual free table to browse through, so bring your extra pieces for others to share.

The kitchen area will be available as usual and we will provide lemonade, coffee, popcorn. etc. Bring a lunch or plan to eat in Vancouver. There will be a snack table, so bring snacks to share with others during the day. However, as in recent meetings, there will be

***NO POTLUCK DINNER***

# STILPNOMELANE IN SKAGIT COUNTY WASHINGTON

**Lorna Goebel**

Stilpnomelane, a relatively rare low grade metamorphic mineral, occurs on Blanchard Hill, Skagit County, Washington. It is probably more widespread than reported since it is easily mistaken for biotite both in hand specimens and thin sections. The mineral here occurs as thin black radiating crystals. The diameter of each group is about one-fourth inch.

## LOCATION

Blanchard Hill is just south of the Whatcom - Skagit County line in Skagit County. The technical location is Sec 11 T 36N R 3E. To reach the locality take the Alger Exit (#240) off of I-5 south of Bellingham, turn west towards Lake Samish. In about 0.5 mile turn left onto Barrel Springs Road. After about 0.75 mile turn right onto Blanchard Hill Trail Road and proceed for 2-3 miles. Turn left onto State Forest Service Road B2000. About 0.25 mile down this road is the collecting site.

## HISTORY

This location was first brought to my attention in 1986 by Richard Rantz, who had the mineral identified by Western Washington University. In 1988 and again in 1991 the Washington Department of Natural Resources did work on this locality. In 1995 Friends of Mineralogy took a field trip to the location.

## GEOLOGY

Detailed geology of this area has not been published and since it is in northwestern Washington you can expect it to be very complex. Blanchard Hill lies south of Chuckanut Mountain, which is an anticline with a northwestward plunge. This location is obviously on the face of a fault - slickensides are numerous. It has been reported that this fault is at the contact between the Chuckanut Formation, a non-marine sedimentary sequence which at this location is the Bellingham Bay member with a thickness of 2700m (8,900ft) in the vicinity of Bellingham. The lithology of the Chuckanut Formation in the area is fine to coarse-grained sandstone. The Chuckanut unconformity overlies metamorphosed pre-Tertiary rocks of the Shuksen Metamorphic Suite. Some geologists think that the Shuksen Suite is metamorphosed Yellow Aster Formation. This metamorphic suite is composed of greenshist and blueschists facies. Locally Darrington Phyllite is exposed, which has been metamorphosed to the blueschist facie.

## MINERALOGY

Stilpnomelane is a triclinic phyllosilicate. It is really a series of minerals ranging from a high ferrous iron to a high manganese aluminum silicate. The two end members are ferrostilpnomelane for the iron member and franklinphilite for the manganese analogue. Parsettensite, a manganese rich phyllosilicate, was originally thought to be a member of this series, but it has a different structure. Nickel and Nichols give the chemical formula as $(K,Ca,Na)(Fe,Mg,Al)_{12}(Si,Al)_{16}(O,OH)_{54} \cdot nH_2O$. Titanium and manganese substitute for the iron and an idealized average chemical formula has been proposed as $K_5Fe^{2+}Si_{64}Al_8O_{168}(OH)_{45} \cdot 12H_2O$, Miyano and Beukes (1984).

Stilpnomelane is found most frequently in Precambrian metamorphosed iron formations. Occurrences are in Africa, Australia, British Columbia, Canada, China, India, New Zealand, several places in Europe, California, Michigan and Oregon. The fact that these are all Precambrian would support the proposal that the Shuksen Metamorphic suite is metamorphosed Yellow Aster since the Yellow Aster Formation is Devonian or even Cambrian aged basement rock (Mish).

The upper stability limit of stilpnomelane in iron formations is about 430-470°C and 5-6 kilobars. The iron end member containing little manganese is slightly more stable being able to occur at a maximum temperature of 500°C and pressures up to 6-7 kilobars. In the Franciscan Formation, California stilpnomelane has been found associated with quartz, magnetite, siderite, minnesotaite, chlorite, grunerite, and almandine. Stilpnomelane from Franciscan and Santa Catalina Island in paleosubduction zone terranes represents a range of pressure-temperature conditions of 6-15 kb, 300-750°C and is associated with muscovite variety phengite, amphibole, lawsonite, biotite, chlorite, albite, apatite, calcite, clinozoisite, epidote, garnet, ilmenite, titanite, plagioclase, quartz, rutile, and zoisite. At Skookum Gulch, Northern California stilpnomelane is associated with amphibole, chlorite, phengite, lawsonite, titanite, epidote, granet, and tourmaline. The Colebrooke schist in the Coast Range of southwestern Oregon contains stilpnomelane in association with crossite, epidote, albite and iron oxide in meta-igneous rocks which were metamorphosed to 310-340°C and 6-9 kb. The Colebrook Schist has been correlated with the Shuksan Metamorphic Suite. At Blackwater Mountain, British Columbia stilpnomelane is associated with chloritoid, phyrophyllite, muscovite, paragonite, albite, rutile, ilmenite, titanite, biotite, chlorite, tourmaline, and carbonate minerals (calcite and ferroan dolomite).

The stilpnomelane at Blanchard Hill is associated with quartz, calcite, siderite and an unknown green mineral. Actinolite has been reported from the nearby Lizard mountain area.

This is an interesting occurrence in an easily assessable location that overlooks Samish Bay. It certainly needs more work.

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# HARPER MOUNTAIN, SPRAY, WHEELER COUNTY, OREGON

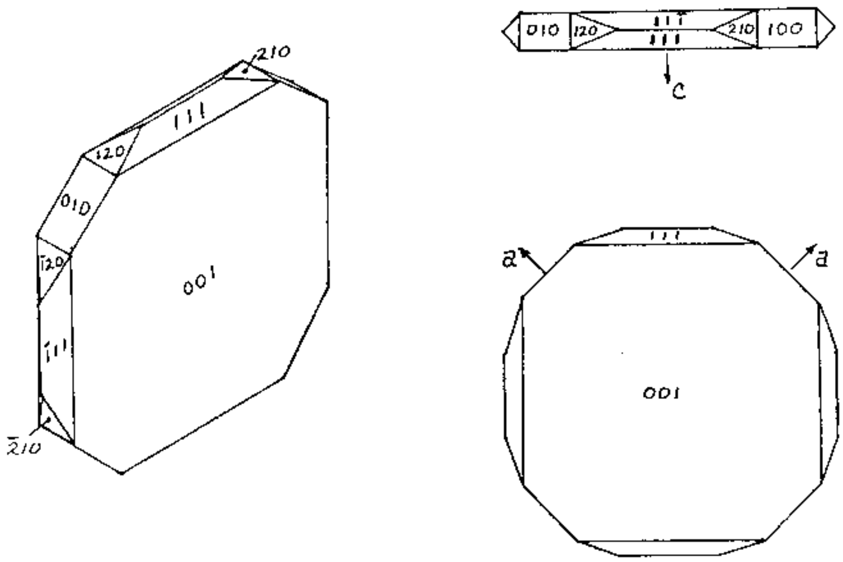
**Donald G. Howard** and **Rudy Tschernich**

Zeolites are common in the lower flows of the Picture Gorge member of the Miocene Columbia River Basalt Group in central Oregon. Many road cuts in this basalt are found along highway 19/207 between Spray and Service Creek in Wheeler county. A particularly interesting one is found along the John Day River at the foot of Harper Mountain, 4.7 miles west of Spray. White zeolites filling cavities can be seen in a long curving roadcut that is actually only a few feet high along most of its length. The site was first noted by Milton Speckels in 1963, but it was not actively collected until 1994. The roadcut itself has not proved to be overly productive, but boulders left from excavating the road provide interesting collecting.

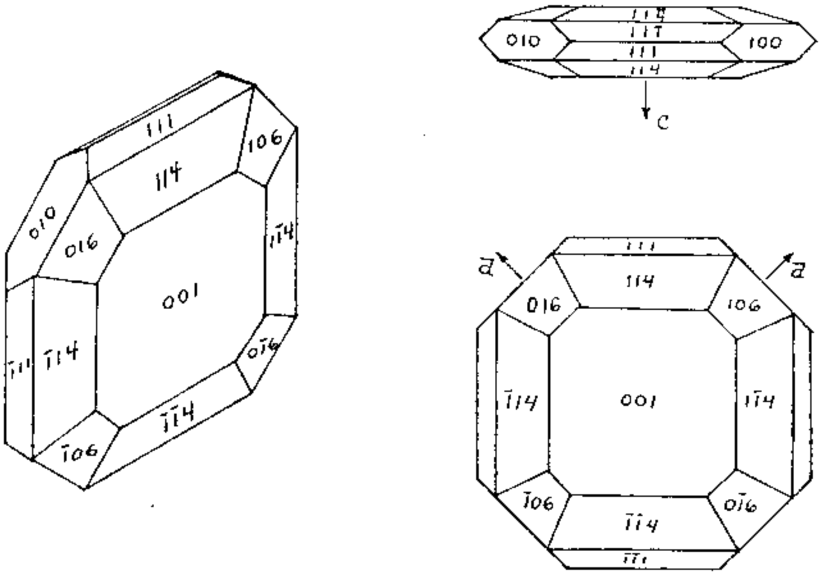
Milepost 86 occurs near the center of the roadcut. A track taking off to the south right beside the milepost winds a short way through the scrubby bushes to end at a sandy bank beneath two juniper trees beside the river in what is clearly an unimproved campsite. This makes a good place off the highway for at least a few cars to park.

In the bushes along this track, particularly to the east of it, numerous small boulders have come to rest. These rocks contain cavities up to two inches in diameter lined with a drusy layer of phillipsite upon which are numerous crystals of apophyllite and clusters of gyrolite. The gyrolite balls are generally a few millimeters in diameter, pale tan colored, generally with smooth surfaces. The apophyllite crystals are very interesting. Most are tabular, flattened along the c-direction with large prominent c faces (001). The edges are composed of (100) and (111) faces of approximately equal development. Many show additional (210) faces of the type described from Monument and Devil's Backbone (see the article on apophyllite in the *Microprobe*, Vol. 7, #2, page 4). A few of the crystal found are particularly thinned to the point of being bladed, such as those shown in Micrographs #231 and #233. These thin blades show additional faces around the c-face that appear to be (114) with striations parallel to the [110] direction. Small corner faces, probably (106), are sometimes present. On these blades, the (111) faces appear to be sharp but the (100) faces often break up to make a series of blades, such as those shown in Micrograph #233. As a result, the outline of the bladed crystals are often rough, even breaking into several crystals in the pattern of a cross, such as that shown in Micrograph #231. The c-faces are pitted in what looks almost like wormholes.

**Habit of tabular Apophyllite from Harper Mountain, Oregon**




More normal habit, with (111) and (100) about equally developed.
Small (120) faces bevel the corners.




Unusual habit of the very thinly bladed crystals.
The c-face is reduced by the presence of (114) faces tipped about 17°.
(106) faces are also shown. For simplicity, (120) faces have been omitted.

The best and most varied collecting can be done in the pile of boulders below the road at the west end of the unimproved campsite. Sample several of the boulders, since each seems to contain a slightly different suite of minerals. Basically, there appears to be three types of rock present. The most abundant is a massive black basalt that contains rounded cavities up to 2 cm in diameter lined with cowlesite, phillipsite, apophyllite, analcime and chabazite as well as numerous, completely filled cavities of garronite. The second type of basalt is lighter colored and contains many tiny filled cavities (under 3 mm in diameter) as well as widely scattered elongated cavities (up to 8 inches long) that were stretched due to movement of the basalt magma as it cooled. These cavities contain an abundance of bladed thomsonite, thin mesolite needles, apophyllite, tacharanite, and chabazite variety phacolite. This rock breaks easily along the flow direction, which allows very large boulders to be taken apart rather easily. A third kind of basalt is reddish with large black pyroxene phenocrysts. It contains only small irregular vesicles lined with colorless pointed stilbite a few millimeters long. The reddish rock is found in place at the west end of the road cut and in the boulders directly across the road.

This location has only been lightly examined to date. The variety of minerals present, and the fact that different boulders contain different assemblages of associates, indicates that much more work at this site is warranted. Though no really rare minerals appear to be present, interesting and unusual forms have been observed that deserve further study.

The minerals present (in approximate order of formation) are:

***Calcite*** forms amber-colored bundles of needles on black clay and is covered by the zeolites.

***Phillipsite*** forms only as blocky drusy crystals beneath the other minerals.

***Analcime*** forms colorless trapezohedra up to 5 mm in diameter that have etched or corroded surfaces.

***Cowlesite*** forms radial hemispheres, up to 3 mm in diameter, composed of tiny pointed blades. on a background of black clay.

***Garronite*** Occurs as completely filled irregular cavities up to 2 cm long. The mineral is bluish-white in color and shows the usual radial structure with concentric cracking.

***Levyne*** is rarely present as thick tabular colorless crystals that are highly fractured.

***Chabazite*** forms both as rhombohedra and as twins (phacolite) up to 10 mm across. They are clear but their surfaces appear corroded or etched. The chabazite is very brittle and difficult to remove intact.

***Tacharanite*** forms chalky white porcelain-like mounds often with gyrolite and thomsonite.

***Gyrolite*** forms white hemispheres 1 to 3 mm in diameter that are composed of compact hexagonal plates. A later generation is in somewhat larger tan balls that generally have a smooth surface but often appear etched or partially dissolved.

***Thomsonite*** formed several times in the cavities. The early generation forms small balls or grayish layers in the cavities, and is followed by tacharanite, gyrolite and apophyllite (see photograph #15). A later generation formed larger crystals, radiating mounds, and odd pointed growths that probably grew around a mesolite needle. This last generation of thomsonite coated mesolite to form stiff needles and balls several centimeters in diameter, similar to those found at Neer Road, Goble.

***Mesolite*** formed very thin, hair-like needles, often coated or covered by thomsonite. If free in the larger elongated cavities, it mats down easily. In general, it is best removed during cleaning to produce better specimens of thomsonite.

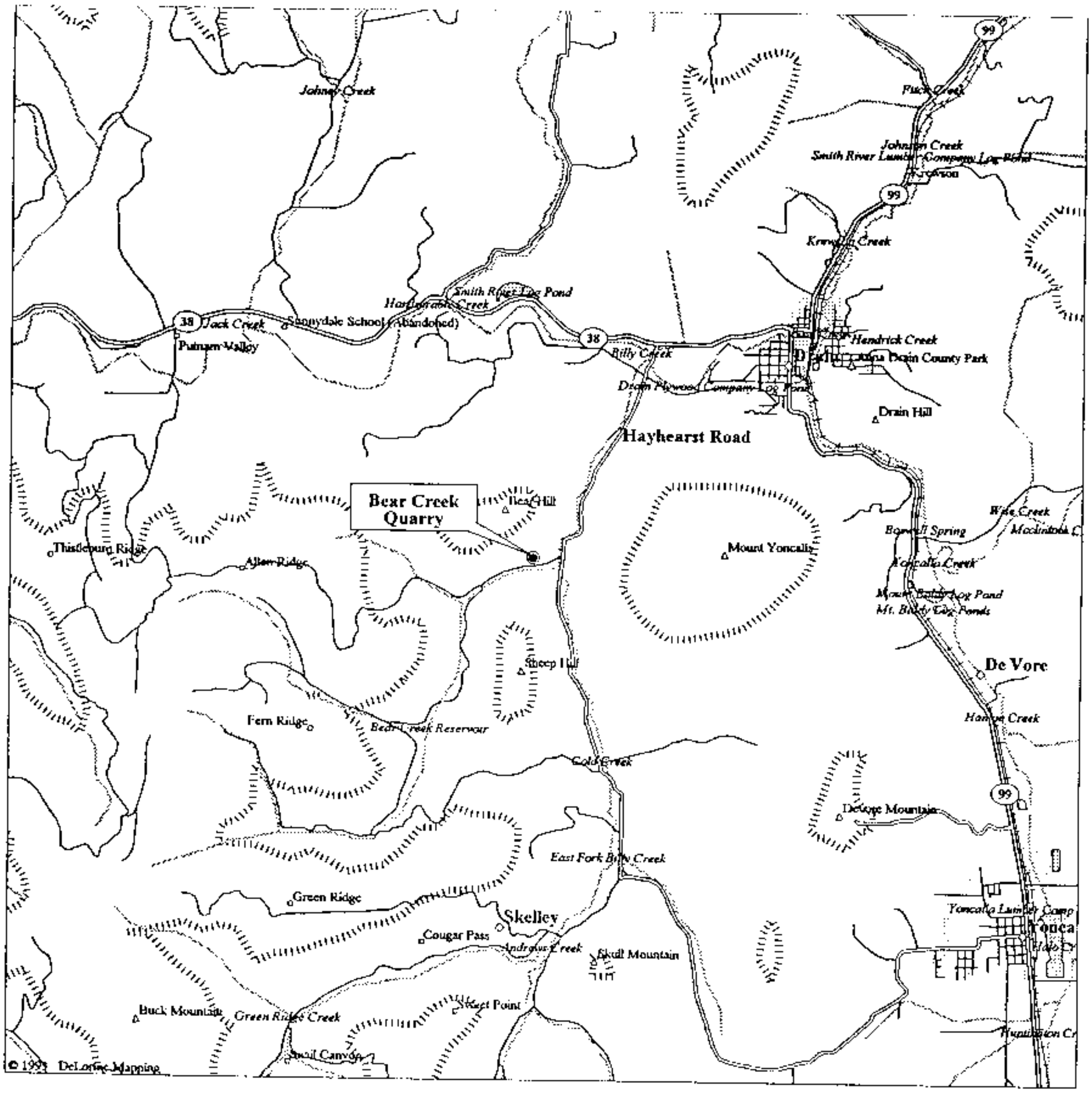
***Apophyllite*** forms as clear tabular crystals, up to 10 mm across, most commonly on phillipsite. Some crystals are so thin as to appear bladed, and are often in parallel groups. The surfaces generally appear coated or etched, and the edges of the bladed crystals are rather irregular. Numerous unusual faces are present (see discussion above).

*Observed sequences of crystallization:*

calcite>cowlesite>gyrolite>chabazite>dissolution of gyrolite
analcime>gyrolite
chabazite var. phacolite>gyrolite>thomsonite(compact)>thomsonite(white)>
chabazite(rhomb)>dissolution of gyrolite
calcite>analcime>tacharanite>gyrolite>thomsonite growths>mesolite
phillipsite>tacharanite
phillipsite>gyrolite>chabazite
phillipsite>apophyllite>gyrolite
analcime>levyne>gyrolite
analcime>thomsonite>mesolite
analcime>tacharanite

*Generalized sequence of crystallization:*

calcite>phillipsite>analcime-cowlesite-garronite-levyne-offretite>chabazite var. phacolite> tacharanite>gyrolite>thomsonite(compact)>mesolite>thomsonite(white)>apophyllite> gyrolite>chabazite(rhombohedral)




LEGEND

- Population Center
- State Route
- Geo Feature
- Town, Small City
- Hill
- Park
- Street, Road
- Major Street/Road
- State Route
- Interstate Highway
- Railroad
- River
- Open Water
- Contour

Scale 1:62,500 (at center)

1 Miles

2 KM

Bear Creek Quarry
Mag 13.00
Sun Mar 17 14:20:42 1996

# Zeolites from the Bear Creek Quarry, Drain, Douglas County, Oregon

by
Rudy Tschernich

The Bear Creek Quarry has been one of the best collecting sites for zeolites in Oregon for over 40 years. This locality has produced superb specimens of bladed thomsonite, long thin needles of mesolite, and large laumontite crystals. Al McGuinness was the first mineral collector to discover the fine zeolites at this quarry. At that time he sold dynamite for the Atlas Powder Company and had the task of visiting many of the quarries to take orders. A great way to make contact owners and gain access to the quarries. The quarry was first operated in the early 1950s. Al first became aware of the quarry in the late 1950's and along with Mike Groben were the principle collectors for over 10 years. It was not until 1972 that other collectors in the Pacific Northwest became aware of the quarry. Mr. Whipple, the first owner of the quarry, and later owners have had an exceptional relationship with mineral collectors. In a time when access to active quarries is difficult or totally closed, the Bear Creek Quarry (also known as the Whipple Quarry) has been excellent. Access to the quarry has never been denied. When a gate at the entrance is closed, we can always walk 300 yards into the quarry to collect but if the gate is open we can drive right into the quarry even when they are in operation. The quarrymen would save specimens for collectors and would show us where good zeolite-bearing rock was exposed. This relationship should continue if it is not abused.

The quarry can be reached by traveling one mile west of the stop light in Drain on State Highway 38, turning left on to the Hayhearst Road, and following that road for 1.5 miles to the quarry entrance. Turn right across a small bridge and through the gate, if it is open, and up the Bear Creek Valley between piles of crushed rock. Pass the abandoned quarry on the south side of the valley keeping to the right and into the quarry on the north side of the valley (see map).

The rock in the quarry is an early Eocene basalt belonging to the Roseburg Formation. The best zeolites are confined to single, fine-grained, green vesicular flow about 20 feet thick that is tilted 30 degrees to the north. The green color is due to an abundance of nontronite clay in the rock. Large scattered elliptical shaped cavities, commonly up to 18 in diameter with a few reaching several feet across, are found throughout the flow with no obvious concentration at the top or bottom of the flow. At the base of the zeolite-bearing flow is a soft altered reddish layer the may have been the surface of a lower flow. This layer often contains large irregular interconnected thin cavities that are lined with wooden match stick sized laumontite crystals, about one inch long. Calcite is the only other mineral found in these laumontite-cavities. Because the soft rock easily separates from the laumontite, good sized specimens of pure laumontite crystals were obtained from this zone. Laumontite, small blades of thomsonite, and calcite are found sporadically in seams and pockets throughout the other soft rock in the quarry but seldom produces good specimens.

The rock in the zeolite-bearing flow is fine-grained, hard and brittle but breaks when hit with a heavy hammer. Boulders over 3 feet in diameter are hard to break with a 8-lb. hammer and chisels do not work in the hard rock unless cracks are already present. Very large boulders that will not go through the crusher are broken with a large metal wrecking ball on a boom. It is dropped on the boulder until it cracks. If you are lucky enough to find one of these boulders that have been cracked and is full of zeolites your work is partly done for you. The rock from the zeolite-bearing flow is resistant to weathering and should make excellent crushed rock but has become a problem for the quarry operators. It is so sharp when broken that it cuts and wears out the rubber belts on the conveyors and has been called the "Whipple arrowheads" by the county road crews because it punchers tires so easily. The county will not use the rock if they know it came from the Bear Creek Quarry. For these reasons work is being done on the north wall of the quarry where the basalt is much softer.

In the 1960's and 70's zeolite production was great. The zeolite-bearing flow was exposed completely across the floor and west end of the quarry and many fine specimens were collected. In the late 1970's and early 1980's production stopped in the quarry and was conducted on southern side of the Bear Creek Valley in a quarry that is completely barren of zeolites. In the late 1980's until present, work has again been in the northern quarry where the zeolites are found. During this time an exceptionally good boulder over 10 feet long, 4 feet wide and 4 feet thick, was exposed at the base of the boulder pile right next to where we could park. The boulder was full of elliptical cavities up to 18 inches across, lined with thomsonite, mesolite, and often tiny calcite crystals that looked like dew drops on the needles . Fortunately it had been cracked with the wrecking ball. It took four collecting trips to completely remove this boulder. Later blasting in the floor of the quarry and the east end produced more specimens but signaled the end of the best zeolite production in the quarry. The east end of the quarry, where the last of the zeolite-bearing flow was exposed, is now covered over with soil and the floor of the quarry is covered over in order to get to the northern wall. Great care must be taken when collecting in the Bear Creek Quarry. The high vertical north wall of the quarry is very dangerous. It is about 200 feet high with inviting rubble at its base that lures collectors. Even a small rock dropping that distance can be deadly even with a hard hat. We have seen several times when tons of rock dropped off the wall without any warning. Do not even approach the north wall. The north wall is now being benched by blasting from the top. Maybe they will encounter another zeolite-rich flow.

The minerals in the Bear Creek Quarry are described in the order which they first crystallized in the cavities. Excellent display specimens of thomsonite, mesolite, laumontite, analcime, and calcite are abundant with only traces of chabazite, levyne, and pyrite.

CLAY forms a thin light green lining in all of the cavities and precedes zeolite crystallization. It has been identified at the University of Oregon as the sodium-iron rich nontronite. Nontronite also replaces the glass and some of the minerals in the rock to give it a characteristic green color.

PYRITE has been found in a few cavities. It forms small cubes that make aggregates, up to 4 mm across.

LEVYNE is one of the least noticed minerals at the Bear Creek Quarry. It went unnoticed for years until someone looked at some of the tiny cavities that are widely scattered in the rock. It is transparent, colorless to light yellow and does not have a white offretite coating on its surface. The crystals are rather thick with a large c-face and large beveled faces on the edges. Levyne has only been found alone in the smallest of cavities. If it is present in larger cavities it has gone unnoticed because it is covered by other zeolites.

ANALCIME is common but not conspicuous at the Bear Creek Quarry. It forms colorless to milky-white trapezohedra, up to 8 mm in diameter, lining some of the cavities and is often covered with thomsonite and mesolite. Some analcime crystals are particularly attractive when colored pink or red from hematite inclusions or coatings. Analcime appears to be the first zeolite to crystallize in the large cavities and is commonly completely overgrown by later-formed minerals. Many of the analcime crystals are skeletal from partial dissolution that probably took place during later zeolite crystallization.

THOMSONITE is the most abundant mineral at the Bear Creek Quarry and makes some of the finest display specimens of bladed thomsonite in the world. It is found in cavities up to 2 feet in diameter although the majority of the cavities are 2 to 18 inches across. A layer of thomsonite, 1 to 3 cm thick, is common in the cavities and is formed of several different generations. An early period formed a compact, fined-grained, white, radiating hemisphere that became the core of the aggregates. Later-formed layers are colored green from clay inclusions or pink from hematite inclusions and the final layer is composed of very coarse colorless thin blades, up to 8 mm long. Balls or mounds of thomsonite often are 1.5 inches in diameter. The thomsonite is followed by long thin mesolite needles on which commonly are found rectangular doubly-terminated thomsonite blades. Red hematite coatings on some of the thomsonite blades makes exceptional specimens.

Some of the large colored-zoned thomsonite eyes, up to 2 inches in diameter, have been cut and polished like the so called "thomsonite" from Lake Superior that is really a combination of thomsonite, mesolite, scolecite, and prehnite.

MESOLITE forms attractive, long, transparent, colorless, thin, hair-like needles, up to 5 cm long, that extend from the bladed thomsonite cavity lining. Some mesolite needles, colored red from a hematite coating, are highly prized. In a few cavities, after crystallization of the mesolite, a repeat of clay, thomsonite, analcime plus chabazite, laumontite, and calcite occurred that formed tiny crystals on the mesolite needles.

CHABAZITE has been observed in only a couple of cavities. It forms, colorless, transparent rhombohedra, under 1 mm across, scattered on mesolite needles.

LAUMONTITE forms exceptional specimens at the Bear Creek Quarry. If the laumontite is removed while it is still fresh it has an attractive translucent pink color and is quite hard but if left in the dry air even for a few hours it will turn chalky white and fall apart. Fresh specimens should be immediately covered with wet paper towels and kept wet until a method to preserve them can be applied. Laumontite that is already white will not become hard and fresh again even if it is covered with water.

Two different environments are noted for the laumontite. The first and most wide spread is the large elliptical cavities throughout the zeolite-bearing flow. In these cavities the laumontite forms stout prisms, 1 to 2 cm across and 2 to 5 cm long, that are found on thomsonite and calcite crystals. The second environment is in the altered red zone below the main flow. This area consists of large flatten interconnecting cavities, up to 2 feet across but only a few inches high. Laumontite found in these cavities are the size of wooden match sticks (2 mm wide and inch long). Large plates of these crystals are nearly pure laumontite. Small calcite crystals are commonly found on the laumontite crystals and in a few cavities large amber-colored calcite crystals, up to 3 inches across, are covered with laumontite crystals.

CALCITE is commonly found on the zeolites in the Bear Creek Quarry. It generally is colorless to light yellow although shades of bright orange to dark amber have been found. The crystals often form complex rhombohedra with many extra faces. Highly faceted calcite crystals, up to 10 mm long, are very attractive when found on mesolite needles. Large calcite crystals, up to 4 inches have been found. The calcite crystallizes near the end of the crystallization sequence both on and under laumontite.

The mineral appear to have crystallized in the order: nontronite > pyrite > levyne > analcime > thomsonite > mesolite > (drusy thomsonite-analcime- chabazite) > calcite > laumontite > calcite.

# Zeolites from Kalama, Cowlitz County, Washington

by
Rudy W. Tschernich

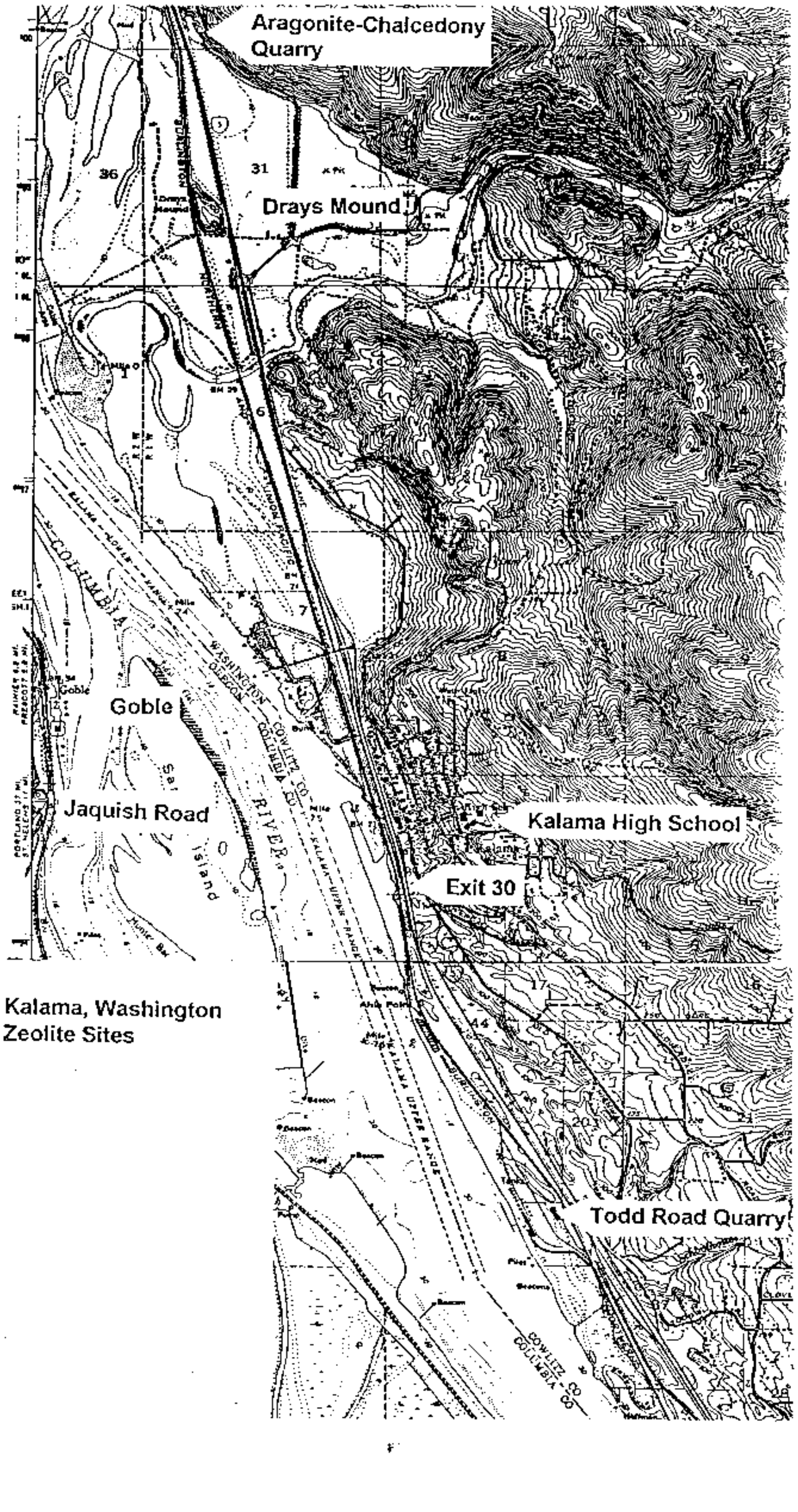
A little appreciated zeolite area that has produced exceptional zeolites in the past is present along Interstate 5 near Kalama, Cowlitz County, Washington. Dake (1945) mentions excellent zeolites were found by collectors in new road cuts in basalt south of Kalama when the Pacific Highway (Highway 99) was constructed. More fine specimens were found in basalt cliffs south of Kalama near Cloverdale in 1953-54 when the two lane Interstate 5 was constructed (Mike Groben, pers. comm.). During this time exceptional specimens of analcime up to 3/4 inch in diameter were found as well as large pockets lined with stilbite. Most of the better crystals were found during 1970-71 when Interstate 5 was widened to four lanes. More collectors were present at this time to save the minerals that were exposed during construction. Several sites have been productive (see map).

The northern most site was in a quarry adjacent to I-5, on the east side, 3 miles north of Kalama. This site is just south of the wire-covered cliffs along I-5. It now appears little more than a wide field with cliff walls. Large cavities or tubes, over 12 inches in diameter and up to 6 feet long were found in the walls of the quarry that were lined with a gray-colored shell of chalcedony and calcite on which extended attractive colorless aragonite needles, several inches long. Radiating masses of coarser aragonite prisms, up to 5 inches long and a centimeter across, were often mistaken for mesolite or scolecite. Zeolites were not found in this area.

Further south, I-5 cut through the side of a hill named Drays Mound on the west side of the freeway just north of Exit 32 and exposed numerous vesicular and fragmental flows that contained an abundance of drusy heulandite rarely associated with native copper or elongated prisms of phillipsite. The zeolites in this cut were generally tiny and unimpressive.

Within the town of Kalama, zeolites were found during construction of a foot ball field behind the Kalama High School during 1994-95. White mordenite was abundant with some calcite, stilbite, heulandite, blue-green copper stains, and chalcedony.

The best zeolites were found just south of Kalama. Today's southbound lanes are the remains of the old two lane I-5 that produced specimens in the 1950s. Construction of the northbound lanes in the 1970s required removal of vast amounts of rock from a ridge that extended in the north near Exit 30 (south of Kalama) and for several miles to the south. The rock blasted from this ridge (about 20 feet high) was used to fill in the low places in the road and dumped just west of Drays Mound. Rock in this ridge produced an abundance of zeolites over the period of construction. Hard massive areas in the flows contained widely scattered cavities, often up to 10 inches across with a few reaching several feet, that contained large crystals of stilbite, chalcedony, or aragonite. Colorless intergrown quartz-filled nodules up to 100 lbs. and smaller 10 inch cavities lined with amethyst quartz were found in some areas (Paul Lawson, pers. comm.). Soft highly vesicular gray or red basalt at the tops and bottoms of the flows were much richer in small cavities and zeolites. These cavities were all lined with drusy heulandite and thin white mordenite hair that were covered with drusy chabazite. Less commonly large analcime, stilbite, thomsonite, mesolite, and large chabazite crystals were found. Today, only grass-covered mounds exist between the north and south lanes where the ridge was once present. Exposures of this rock and zeolites can still be found along the northbound lane at Exit 30, although the State Patrol with not allow you to park along the freeway.




Kalama, Washington
Zeolite Sites

Near the southern most end of the ridge area, Todd Road crosses under the freeway (Exit 27) and leads west over the railroad tracks to a group of industrial buildings. Large cavities lined with stilbite were found north of Todd Road along the railroad tracks. In one of these pockets a log-like specimen, 4 inches in diameter and 12 inches long, was found studded with stilbite crystals (Paul Lawson, pers. comm.). In the 1970s a small hill was present north of Todd Road just west of the railroad tracks. A small quarry in this hill, called the Todd Road Quarry, was present for several years after construction of I-5. A zeolite-rich zone in the upper part of the quarry contained cavities, up to 6 inches across, that were lined with an abundance of white mordenite needles along with colorless flat-topped stilbite, several inches long. Epistilbite and chabazite were also found in this quarry. Later the hill was leveled and the Madill Mill was build on the quarry site.

The ridge between the lanes that extended for a mile further south from Todd Road, generally did not contain zeolites, although a couple of outstanding cavities were found. One contained colorless, transparent apophyllite, up to 1.5 inches long, with pointed terminations in a cavity 6 inches across (Paul Lawson, pers. comm.). Another cavity contained analcime with copper inclusions.

The minerals found at Kalama are listed in the order in which they crystallized.

CLAY formed an inconspicuous 1-mm thick lining in the cavities preceding zeolite crystallization.

COPPER was found at Drays Mound and in analcime south of Todds Road. Blue-green stains found on the mordenite and other minerals at many places at Kalama indicates that copper was more widely distributed but has become altered to copper oxides, carbonates, or silicates.

CELADONITE formed yellow-green tufts of needles on or within drusy heulandite.

MORDENITE usually formed soft matted needles, up to one inch long, and when present is the first zeolite to crystallize. It occurred with heulandite in many of the cavities and was often covered with tiny chabazite, calcite, or stilbite. Mordenite in exposed cavities rapidly weathers to a gray matted mass. Rarely mordenite was covered by chalcedony in some of the silica-rich quartz-calcite cavities.

HEULANDITE is very common at Kalama. It formed a drusy lining on the clay or mordenite in most of the cavities. The crystals are colorless to white, often transmitting the color of the clay under the crystals. They are either thin pointed crystals, only a few millimeters long, or larger blocky crystals up to one inch. Some heulandite is colored an attractive green from inclusions of celadonite.

EPISTILBITE was very rarely found on mordenite in the Todd Road Quarry. It may have been more common in the cavities but went unnoticed.

STILBITE formed excellent specimens at Kalama. They were lustrous, translucent, colorless to milky-colored bow-ties and aggregates, up to 3 inches across. Mounds of stilbite up to 15 inches across were found in a few cavities. In the Todd Road Quarry, lustrous, colorless stilbite crystals, up to 2 inches long, were found with mushroom-like heads, and flatten terminations, on white mordenite fibers. Excellent specimens of cream-colored bow ties and flat-topped aggregates of stilbite, up to 3 inches long, were found on white mordenite needles in a few pockets.

ANALCIME formed colorless, transparent trapezohedra, up to 1 inch in diameter, on drusy heulandite. The best specimens of analcime were found during the 1953-54 construction. One cavity found at the southern end of the ridge in 1970 contained analcime with copper inclusions.

THOMSONITE was rather scarce at Kalama. It formed smooth-surfaced, highly lustrous, blue-gray hemispheres, up to 15 mm in diameter, on drusy heulandite and is associated with mesolite, chabazite, stilbite, and analcime.

MESOLITE was scarce at Kalama. It formed very short needles, a few millimeters long, covering thomsonite hemispheres and rarely formed coarser prisms, 1 mm wide and several centimeters, long.

PHILLIPSITE was found only in cavities in the rock exposure at Drays Mound north of Kalama. It formed cream-colored, long prisms, terminated by four diamond shaped faces on drusy heulandite. The crystals often contained phantoms.

CHABAZITE formed both rhombohedra and phacolite twins. Most of the drusy chabazite scattered on mordenite and other zeolites were tiny rhombohedra under 1 mm across. Rarely rhombohedra, up to 1.4 inches across, were found. Kalama was noted for exceptional specimens of twinned phacolite crystals, usually up to 10 mm across, although a few up to 1 inch in diameter were found.

APOPHYLLITE was found only in one cavity at the far south end of the ridge between the I-5 lanes. It formed colorless pointed crystals up to 1.5 inch long (Paul Lawson, pers. comm.).

LAUMONTITE has been mentioned by some collectors to occur at Kalama although it has not positively been identified by the author.

Although zeolites present at Kalama were not associated with quartz or chalcedony, many large high-silica cavities were found that contained quartz, chalcedony, calcite, and aragonite. In a few of these cavities traces of mordenite were found that were covered with chalcedony. A description of these high-silica cavities follows.

CHALCEDONY formed a blue-gray layer, up to an inch thick, in some cavities, up to 12 inches in diameter, near the Kalama freeway Exit 30 and in tubes, up to 6 feet long, north of Kalama. Calcite or aragonite crystals were commonly found on or intergrown with the chalcedony. Zeolites were noticeably absent.

CALCITE formed cream-colored scepter calcite crystals, up to 10 mm long, on chalcedony near the Exit 30. One exceptional calcite crystal, 4 inches in diameter and 6 inches long, was found. Zoned brown-colored rhombohedra, up to 2 inches across, were found some cavities.

ARAGONITE formed colorless, transparent needles, up to 2 inches long, on chalcedony in horizontal tubes north of Kalama. Many of the aragonite needles were damaged when specimens were removed from the hard rock. In the same area masses of coarse aragonite needles and prisms, up to 5 inches long, resembled massive mesolite or scolecite. These were often associated with cream-colored rhombohedra of calcite.

The minerals appear to have crystallized in the order: clay > copper > mordenite > celadonite > heulandite > epistilbite > stilbite > phillipsite > thomsonite > analcime > mesolite > chabazite > calcite.

A comparison of the minerals found at Kalama with those found only a mile and a half directly across the Columbia River at Goble, Oregon is inescapable. Both areas are in Upper Eocene Goble Volcanics. Solutions that deposited zeolites in the Goble area are believed to have followed vertical faults that trend east-west. The faults probably extend under the river to the Kalama area. Although the sequence of crystallization is very similar at both localities, the abundance, crystal habit, and size of the crystals of various species are different. Drusy heulandite commonly lines the cavities at both sites. Small stilbite crystals are very common at Goble while stilbite at Kalama can be several inches long. Mesolite and thomsonite are very common a Goble but are scarce at Kalama. Chabazite is abundant at both sites. At Goble the rhombohedral form is dominant (with the exception of the Goble Quarry) while at Kalama the twinned phacolite is dominant. Mordenite, chalcedony, and calcite are more common at Kalama. Cowlesite, tschernichite, and boggsite now found at Goble had not even been found or described when the road cut at Kalama was made.

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## FIGURE CAPTIONS

*Color Photograph Number is in the upper left corner on the back of the print.*

**#14 Stilpnomelane in Quartz** **(x 10)**
**Blanchard Hill, Skagit Co., Washington**
A radial spherule of platey crystals in granular quartz

**#15 Apophyllite on Thomsonite** **(x 7)**
**Harper Mountain, Wheeler Co., Oregon**
A single prism of clear apophyllite amid several generations of thomsonite. Some of the growths probably cover mesolite needles.

*Micrograph Number is in the lower right corner on the front of the print.*

**#231 Apophyllite on Phillipsite** **(x 30)**
**Harper Mountain, Wheeler Co., Oregon**
A cross-shaped bladed crystal, showing the "wormholes" in the c-face and the odd, tapered faces surrounding it. The (100) faces here are totally missing. Notice the striations on the (114) faces and the (106) faces as well..

**#233 Apophyllite on Phillipsite** **(x 20)**
**Harper Mountain, Wheeler Co., Oregon**
Bladed crystals often form parallel groups as in this view. Again, the "wormholes" and the striated (114) and (106) faces are visible. The edge view in the group at right shows the anglular spread of the (106) faces.

**#235 Gmelinite on Chabazite *variety* Phacolite** **(x 50)**
**Devil's Backbone, N. Fk. John Day R., Grant Co., Oregon**
A late generation prism of gmelinite growing on the ends of the twins making up the phacolite. Chabazite appears to form the upper termination of the gmelinite as well.

**#235 Chabazite *variety* Phacolite on Gismondine on Phillipsite** **(x 40)**
**Devil's Backbone, N. Fk. John Day R., Grant Co., Oregon**
A stack of phacolite rosettes, glassy clear. The small, white crystals of gismondine are visible underneath in the light microscope.

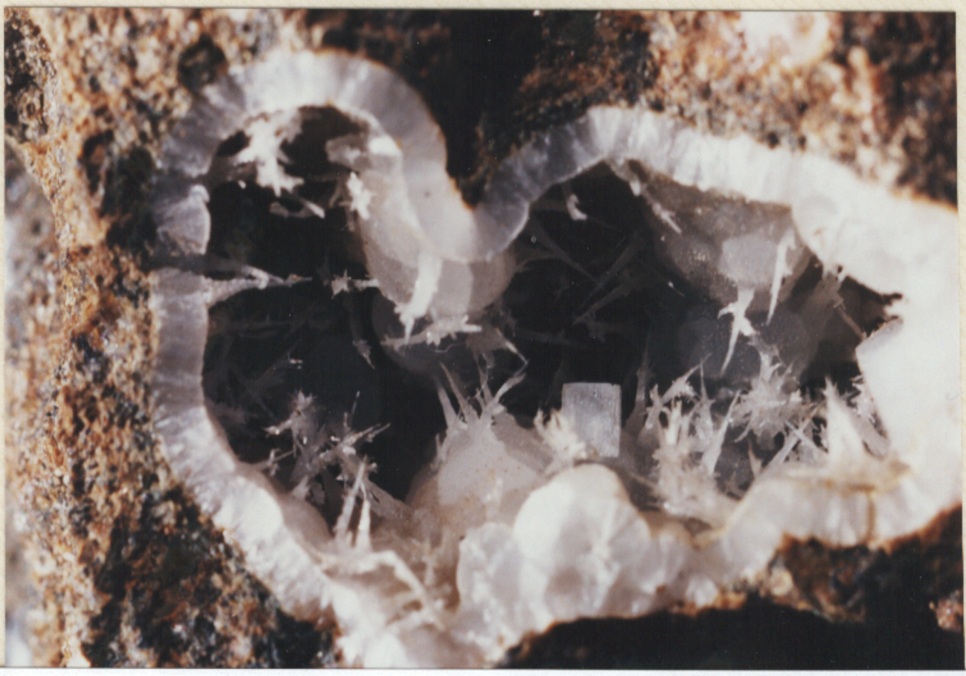
**#241 Thomsonite** **(x 30)**
**Bear Creek Quarry, Drain, Douglas Co., Oregon**
Shingle-like, tapered blades that come to a chisel-like edge. Parallel growth is very common. The fine needles are mesolite. Small bundles of this type often are suspended upon the needles that they surround.

*PHOTO CREDITS*

Specimen #14 *Lorna Goeble*

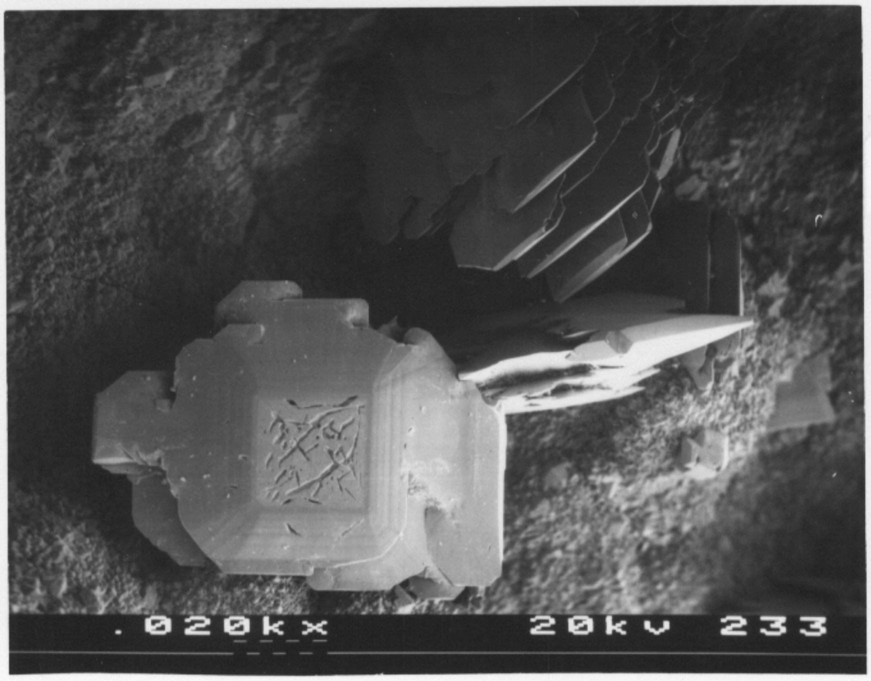
Photographs, Micrographs and other specimens: *Donald Howard*

#14 – STILPNOMELANE, QUARTZ – BLANCHARD HILL, SKAGIT COUNTY, WASHINGTON – 10X



#15 – APOPHYLLITE, THOMSONITE – HARPER MOUNTAIN, WHEELER COUNTY, OREGON – 7X


#231 – APOPHYLLITE, PHILLIPSITE – HARPER MOUNTAIN, WHEELER COUNTY, OREGON – 30X




#233 – APOPHYLLITE, PHILLIPSITE – HARPER MOUNTAIN, WHEELER COUNTY, OREGON – 20X


#235 – GMELINITE, CHABAZITE – DEVIL'S BACKBONE, NORTH FORK JOHN DAY, GRANT COUNTY, OREGON – 50X


#238 – CHABAZITE, GISMONDINE – DEVIL'S BACKBONE, NORTH FORK JOHN DAY, GRANT COUNTY, OREGON – 40X


#241 – THOMSONITE – BEAR CREEK QUARRY, DRAIN, DOUGLAS COUNTY, OREGON – 30X